1 **CLAIMS**

2 What is claimed is:

3 1. A method for imparting a watermark onto a digitized image,
4 said method comprising:

5 providing a digitized image having at least one image plane,
6 said image plane being represented by an image array having
7 a plurality of pixels, said pixel having at least one color
8 component, said watermark being formed using a distinct
9 watermarking plane represented by an array having a
10 plurality of distinct watermarking elements, each of said
11 distinct watermarking elements having an array position and
12 having one-to-one positional correspondence with said image
13 pixels, and

14 multiplying said brightness data associated with said at
15 least one color component by a predetermined brightness
16 multiplying factor, wherein said brightness multiplying
17 factor is a corresponding distinct watermarking element, and
18 said watermark has a invisibility classification.

19 2. A method as recited in claim 1, wherein said brightness
20 multiplying factor has a relationship with a number taken from a
21 random number sequence.

22 3. A method as recited in claim 2, wherein said relationship is
23 a linear remapping to provide a desired modulation strength.

1   4.   A method as recited in claim 3, wherein said modulation
2   strength lies in the domain greater than or equal to zero and
3   less than or equal to 0.5.

4   5.   A method for imparting a watermark onto a digitized image
5   comprising the steps of:

6   providing said digitized image comprised of a plurality of
7   pixels, wherein each of said pixels includes brightness data
8   that represents a brightness of at least one color; and

9   altering said brightness data associated with a plurality of
10   said pixels maintaining the hue and saturation of said
11   pixel.

12 6.   A method as recited in claim 5, wherein said image has I
13 rows and J columns, and has a pixel in row i and column j having
14 at least one brightness, Y(i,j), and the step of altering
15 includes:

16 adding to or subtracting from the brightness Y(i,j) a different
17 small random value $\varepsilon(i,j)$, wherein $1 \leq i \leq I$ and $1 \leq j \leq J$ are
18 the row and column indices of a pixel location in the image.

19 7.   A method as recited in claim 6, wherein the step of adding
20 to or subtracting from includes making $\varepsilon(i,j)$ proportional to an
21 original brightness of the pixel.

22 8.   A method as recited in claim 6, wherein color components of
23 the unaltered pixel are X(i,j), Y(i,j), and Z(i,j), and color

1   components of the brightness altered pixel are $X'(i,j)$, $Y'(i,j)$,

2   and $Z'(i,j)$, and the step of adding to or subtracting from

3   includes setting $\varepsilon(i,j) = \delta(i,j)Y(i,j)$, where $\delta(i,j)$ is a value

4   selected from an array of random values within a range of $0 \leq$

5     $\delta(i,j) \leq 1$, such that the modified brightness $Y'(i,j) =$

6     $Y(i,j)+\varepsilon(i,j) = Y(i,j)+\delta(i,j)Y(i,j)$, and $X'(i,j)/X(i,j) =$

7     $Z'(i,j)/Z(i,j) = Y'(i,j)/Y(i,j) = \varepsilon(i,j) = 1-\delta(i,j)$.

8   9.   A method as recited in claim 8, wherein the step of setting

9   includes preserving ratios of color components in each pixel.

10   10.   A method as recited in claim 9, wherein the step of

11   preserving includes setting $X'(i,j)/X(i,j) = Z'(i,j)/Z(i,j) =$

12     $Y'(i,j)/Y(i,j) = 1-\delta(i,j)$, wherein the color components of the

13   unaltered pixel are $X(i,j)$, $Y(i,j)$, and $Z(i,j)$, and the color

14   components of the brightness altered pixel are $X'(i,j)$, $Y'(i,j)$,

15   and $Z'(i,j)$.

16   11.   A method for imparting a watermark onto a digitized image

17   comprising the steps of:

18   providing said digitized image comprised of a plurality of

19   pixels, wherein each of said pixels includes brightness data

20   that represents a brightness of at least one color, with

21   said image having I rows and J columns, and a pixel in row i

22   and column j having a brightness $Y(i,j)$; and

23   for a plurality i and at least one j adding to or

24   subtracting from the brightness $Y(i,j)$ a random value

1    $\varepsilon(i,j)$, wherein $1 \leq i \leq I$ and $1 \leq j \leq J$ are the row and

2   column indices of a pixel location in the image.

3   12. A method as recited in claim 11, wherein $\varepsilon(i,j)$ is in the

4   domain 0 to 1 multiplied by $Y(i,j)$.

5   13. A method for generating a watermarked image, the method

6   comprising:

         imparting a watermark onto a digitized image having a

         plurality of original pixels, each of said pixels having at

         least one original pixel brightness value;

10   providing said digitized watermarking plane comprising

11   a plurality of watermarking elements, each element

12   having a watermark brightness multiplying factor and

13   having one-to-one positional correspondence with said

14   original pixels; and

15   producing a watermarked image by multiplying said

16   original brightness of each of said original pixels by

17   said brightness multiplying factor of a corresponding

18   one of said watermark elements.

19   14. A method comprising:

20   forming a watermarking plane including a plurality of elements

21   each having a brightness adding or subtracting factor, including

22   the steps of:

1   generating a secure random sequence of integers having

2   a first plurality of bits;

3   linearly remapping said random sequence to form a

4   remapped sequence of brightness multiplying factors to

5   provide a desired modulation strength;

6   computing a discrete Fourier transform of said remapped

7   sequence to form a Fourier sequence having frequency

8   coordinates;

9   expanding said frequency coordinates to form an

10   expanded sequence;

11   computing an inverse discrete Fourier transform of said

12   expanded sequence to obtain a watermarking sequence of

13   values; and

14   deriving said brightness adding or subtracting values

15   of said elements of said watermarking plane based upon

16   said watermarking sequence of values.

17   15. A method for detecting a watermark in a marked image, said

18   method comprising:

19   providing said marked image marked by a watermarking plane,

20   said marked image having at least one color plane including

21   a plurality of image pixels, said watermarking plane having

22   a plurality of watermarking elements, wherein each of said

23   image pixels has at least one brightness value and each of

1　said watermarking elements has a brightness adding and/or
2　subtracting factor, including the steps of:

3　(a) reconstructing said watermarking plane;

4　(b) aligning said watermarking plane with said marked
5　image such that each watermarking element has a
6　corresponding image pixel;

7　(c) providing a selector array and a visualizer image
8　of equal size, wherein said selector array has a
9　plurality of selector elements each having at least one
10　counter, and wherein said visualizer image has a
11　plurality of visualizer pixels each having at least one
12　brightness value, and wherein said visualizer pixels
13　represent a recognizable pattern when displayed;

14　(d) resetting said at least one counter to zero;

15　(e) placing said selector in an initial position by
16　aligning said selector elements with a plurality of
17　corresponding image pixels and a plurality of
18　corresponding watermarking elements;

19　(f) choosing a selector element and identifying a
20　corresponding watermarking element;

21　(g) identifying a first plurality of watermarking
22　elements that neighbor said corresponding watermarking
23　element;

1 (h) generating a first average that represents an
2 average of brightness multiplying factors of said first
3 plurality of watermarking elements;

4 (i) choosing a color plane of said marked image and
5 finding a corresponding image pixel;

6 (j) identifying a first plurality of neighboring pixels
7 that neighbor said corresponding image pixel;

8 (k) generating a second average that represents an
9 average of brightness values of said first plurality of
10 neighboring pixels;

11
12 (l) updating said at least one counter based upon first
13 and second comparison operations, wherein said first
14 comparison operation compares said first average with
15 said brightness multiplying factor of said
16 corresponding watermarking element and said second
17 comparison operation compares said second average with
18 said brightness value of said corresponding pixel;

19 (m) repeating steps (i) through (l) for all color
20 planes;

21 (n) repeating steps (f) through (m) for all selector
22 elements;

23 (o) choosing a new selector position that does not
24 overlap any previous selector position;

1   (p) repeating steps (f) through (o) for all

2   non-overlapping selector positions; and

3   (q) generating a visual representation indicating

4   detection of said watermark in said marked image

5   utilizing said at least one counter of said selector

6   array and said visualizer pixels.

7   16.   A method for detecting a watermarking plane comprising the

8   steps of:

9   providing an image having a plurality of image pixels,

10 u(i,j), with said image having I rows and J columns, and a pixel

11 in row i and column j having at least one component, marked by a

12 watermarking plane; said watermarking plane having a plurality of

13 watermarking elements, w(i,j), with said watermarking plane

14 having I rows and J columns, and an element in row i and column j

15 having a brightness multiplying factor;

16   aligning said watermarking plane with said image;

17   identifying a subset of said image elements;

18   for each pixel, u(i,j), of said subset of image pixels,

19   generating a first value representing a relationship

20   between an attribute of said pixel u(i,j) and an

21   attribute of image pixels that neighbor said pixel

22   u(i,j);

23   identifying a watermarking element, w(i,j), that

24   corresponds to said pixel u(i,j) and watermarking

1 elements that correspond to said image pixels that

2 neighbor said image pixel u(i,j);

3 generating a second value representing a relationship

4 between an attribute of said watermarking element

5 w(i,j) and an attribute of the identified watermarking

6 elements; and

7 generating a coincidence value representing a

8 likelihood that said image is marked by said

9 watermarking plane based upon said first and second

10 values.

11 17. A method as recited in claim 1, wherein said distinct

12 watermarking element, has a value being in the domain greater

13 than or equal to zero and less than or equal to one.

14 18. A method for imparting a watermark onto a digitized image

15 comprising the steps of:

16 providing said digitized image comprised of a plurality

17 of image pixels with said digitized image having I rows

18 and J columns, and a pixel in row i and column j having

19 at least one component, Y(i,j); and

20 adding to or subtracting from said brightness data

21 associated with at least one of said pixels a

22 predetermined brightness adding factor in the range of

23 0 to Y(i,j), or brightness subtracting factor in the

24 range of 0 to Y(i,j).

1   wherein said brightness adding or subtracting factor has a
2   relationship with a number taken from a random number sequence,
3   said relationship is a linear remapping to provide a desired
4   modulation strength, and said modulation strength is less than or
5   equal to 50 percent.

6   19. A method for imparting a watermark onto a digitized image
7   comprising the steps of:

8   providing said digitized image comprised of a plurality
9   of image pixels with said image having I rows and J
10   columns, and a pixel in row i and column j having at
11   least one component, Y(i,j); and

12   adding to or subtracting from said brightness data
13   associated with at least one of said pixels by a
14   predetermined brightness adding or subtracting factor
15   in the range of 0 to Y(i,j),

16   wherein said brightness adding or subtracting factor has a
17   relationship with a number taken from a random number sequence,
18   said relationship is a linear remapping to provide a desired
19   modulation strength, said sequence is formed from a plurality of
20   robust watermarking parameters, and said parameters comprise a
21   cryptographic key, two coefficients and an initial value of said
22   random number generator.

23   20. A method for detecting a watermark, said method comprising:

1   providing a marked image having a plurality of image pixels said
2   marked image being marked by a watermarking plane, having a
3   plurality of watermark elements;

4   aligning said watermarking plane with said marked image, and

5   generating a coincidence value by averaging a detection
6   coincidence for each selector element of a group of selector
7   elements taken from said image pixels.

8
9   21.   A method as recited in claim 20, wherein each of said group
10 of selector elements has a selector size, said method further
11 comprising:

12 providing a visualizer pattern having a plurality of visualizer
13 pixels and a visualizer size equal to said selector size, each of
14 said visualizer pixels being associated with one of said selector
15 elements and having a visualizer color; and

16 displaying a watermark detection pattern having a size at least
17 equal to said visualizer size and a plurality of
18 visualizer-coincidence pixels, wherein each of said
19 visualizer-coincidence pixels is associated with a corresponding
20 selector element and a corresponding visualizer pixel, and each
21 of said visualizer-coincidence pixels being displayed having said
22 visualizer color when said coincidence value of said
23 corresponding selected element has an indication of a detection
24 success and having another color otherwise.

1   22. A method as recited in claim 20 wherein said watermark is
2   based on a factor multiplying a brightness value of each of said
3   image pixels.

4   23. A method as recited in claim 20, further comprising:

5   reconstructing said watermarking plane used in generating said
6   watermark.

7   24. A method as recited in claim 23, wherein said watermarking
8   plane has a plurality of watermarking elements, said method
9   further comprising:

10   rotating, resizing and said image to bring it to a size and
11   position of an original image, and

12   aligning said watermarking plane with said marked image such that
13   each of said watermarking elements has a corresponding image
14   pixel.

15   25. A method as recited in claim 20, wherein each said group
16   contains 128 elements.

17   26. A method as recited in claim 20, wherein each pixel of said
18   image pixels has a monochrome brightness value.

19   27. A method as recited in claim 20, wherein said watermarking
20   plane is generated using a plurality of robust watermarking
21   parameters.

1   28. A method as recited in claim 20, wherein said coincidence

2   variable is determined using a statistically related attribute

3   relating each said selector element to a plurality of neighboring

4   elements.

5   29. A method as recited in claim 28, wherein said attribute is a

6   brightness value.

7

8   30. A method for detecting a .watermark imparted on an image,

9   said method comprising:

10   providing said image having at least one image plane, said image

11   plane being represented by an image array having a plurality of

12   image elements, said watermark being formed using a watermarking

13   plane represented by a watermarking array having a plurality of

14   watermarking elements, each of said watermarking elements having

15   a first array position and having one-to-one positional

16   correspondence with said image elements;

17   computing a first statistically related variable for each element

18   of at least one first grouping of a first selector array of

19   elements taken from said image. elements, wherein each of said

20   image elements has a second array position;

21   computing a second statistically related variable for each

22   element of at least one second grouping of a second selector

23   array of elements. taken from said watermarking elements, wherein

24   each element of said second selector array of elements has

25   one-to-one positional correspondence with said first selector

26   array, and wherein said correspondence forms combinations of

27   corresponding elements;

1 comparing to determine an affirmative and non-affirmative
2 likeness of said first and second statistically related variables
3 for each of said combinations of corresponding elements; and

4 forming at least one comparison array having one-to-one
5 correspondence with said at least one first grouping and having a
6 plurality of comparison elements, wherein each of said comparison
7 elements contains a positive detection indication for each
8 element of said first grouping when said step of comparing
9 results in an affirmative likeness, and a negative detection
10 indication for each element of said first grouping when said step
11 of comparing results in a non-affirmative likeness.

12 31. A method as recited in claim 30, wherein said watermark is
13 formed by adding or subtracting a brightness factor of each of
14 said image elements by an amount contained in a corresponding
15 element of said watermarking elements.

16 32. A method as recited in claim 30, wherein said first grouping
17 corresponds to a selector positioned to encompass said first
18 selector array of elements forming a rectangular cluster of
19 elements.

20 33. A method as recited in claim 30, wherein said first
21 statistical variable is formed by comparing an attribute of said
22 each element of said first selector array of elements to an
23 average attribute of its 128 closest neighbors.

1   34. A method as recited in claim 30, wherein said attribute is a
2   ratio of the color component to the average of neighboring color
3   components in the same color plane.

4   35. A method as recited in claim 30, wherein each of said at
5   least one first grouping is positioned so as not to overlap any
6   other of said at least one first grouping.

7

8   36. A method as recited in claim 30, wherein each said
9   comparison elements has a particular position in said comparison
10   array, said method further comprising:

11   determining an average percentage of said affirmative and
12   non-affirmative likeness of each element of said comparison
13   elements having a same particular position in all arrays of said
14   at least one comparison array, and

15   forming a detection array of elements having one-to-one element
16   correspondence with said comparison elements, wherein each
17   element of said detection array of elements contains said average
18   percentage.

19   37. A method as recited in claim 36, further comprising the
20   steps of:

21   providing a visualizer pattern of pixels represented by an array
22   having visualizer pixels which have one-to-one element
23   correspondence with said detection array, each of said visualizer
24   pixels has a first logical value if a corresponding visualizer
25   pixel is black, and a complementary logical value if said
26   corresponding pixel is white;

1 forming a visualizer coincidence image having a plurality of
2 coincidence pixels, wherein a coincidence pixel has a
3 corresponding visualizer pixel and a corresponding detection
4 array element; and

5 setting said coincidence pixel to black if both said
6 corresponding visualizer pixel is black and said percentage
7 average of said corresponding detection array element has a value
8 greater than a predetermined detection threshold, otherwise
9 setting said coincidence pixel to white.

10 38.   A method as recited in claim 30, wherein said image has
11 three color planes.

12 39.   A method comprising generating a visual representation of a
13 data array of data elements having a data array size, including
14 the steps of:

15   providing a visualizer pattern of visualizer pixels
16   represented by a visualizer array of visualizer pixels, said
17   visualizer array having a visualizer array size equal to
18   said data array size;

19   forming a visualizer-coincidence image of image pixels
20   represented by an image array having an image array size
21   equal to said visualizer array size;

22   setting each said visualizer-coincidence pixel to the color
23   of said corresponding visualizer pixel if a value of said
24   corresponding data element is above a predetermined

1   threshold and to another color if said value is below said

2   predetermined threshold; and

3   displaying said visualizer-coincidence image to form said

4   visual representation.

5 40. A method as recited in claim 39, wherein said data array

6 represents data resulting from a watermark detection

7 implementation.

8 41. A method as recited in claim 39, wherein said first color is

9 black and said second color is white.

10 42. A method as recited in claim 39, wherein said threshold is

11 set at a fifty percent success rate.

12 43. A method for demonstrating an existence of a watermark in a

13 marked image, said image having a plurality of image pixels, said

14 method comprising:

15 providing a visualizer pattern represented by an array of

16 visualizer elements, each of said visualizer elements

17 corresponding with one pixel of a plurality of visualizer pixels

18 and having a first value if said one pixel has a first color and

19 a second value if said one pixel has a second color, said

20 visualizer array having a visualizer array size;

1   implementing a watermark detection scheme and computing a

2   coincidence value for each of said image pixels within a

3   plurality of pixel selector arrays taken from among said image

4   pixels, each of said pixel selector arrays having a selector

5   array size equal to said visualizer array size;

6

7   forming a detection array from a plurality of coincidence values,

8   wherein said detection array has a detection array size equal to

9   said visualizer size; and

10   computing a coincidence detection value for each of said

11   visualizer elements such that said detection value represents a

12   visualizer.

13   44. A method for detecting a watermark in a marked image having a

14   plurality of image pixels, said marked image marked by a

15   watermarking plane having a plurality of watermarking elements,

16   said method comprising:

17   providing a visualizer pattern having a plurality of visualizer

18   pixels and a visualizer size;

19   aligning said watermarking plane with said marked image such that

20   each said image pixel has a corresponding watermarking element;

21   generating a statistically related variable for each image

22   element in a plurality of groupings of image elements in

23   relationship with said corresponding watermarking element;

24   wherein each of said groupings has a grouping size equal to said

25   visualizer size;

1 averaging said variable for each element in a like position of
2 all of said groupings to obtain a composite detection success
3 value; and

4 displaying detection success values by a plurality of
5 visualizer-coincidence pixels having a size equal to said
6 visualizer size, each said visualizer-coincidence pixel having a
7 same color as said corresponding visualizer pixel when said
8 corresponding success value indicates detection success and
9 another color otherwise.

10 45. A computer program product comprising a computer usable
11 medium having computer readable program code means embodied
12 therein for causing a watermark to be imparted into an image, the
13 computer readable program code means in said computer program
14 product comprising computer readable program code means for
15 causing a computer to effect the steps of claim 1.

16 46. A computer program product comprising a computer usable
17 medium having computer readable program code means embodied
18 therein for causing a watermark to be imparted into an image, the
19 computer readable program code means in said computer program
20 product comprising computer readable program code means for
21 causing a computer to effect the steps of claim 5.

22 47. A computer program product comprising a computer usable
23 medium having computer readable program code means embodied
24 therein for causing a watermark to be imparted into an image, the
25 computer readable program code means in said computer program
26 product comprising computer readable program code means for
27 causing a computer to effect the steps of claim 11.

1   48. A computer program product comprising a computer usable
2   medium having computer readable program code means embodied
3   therein for causing generation of a watermarked image, the
4   computer readable program code means in said computer program
5   product comprising computer readable program code means for
6   causing a computer to effect the steps of claim 13.

7   49. A computer program product comprising a computer usable
8   medium having computer readable program code means embodied
9   therein for causing formation of a watermarking plane, the
10   computer readable program code means in said computer program
11   product comprising computer readable program code means for
12   causing a computer to effect the steps of claim 14.

13   50. An article of manufacture comprising a computer usable medium
14   having computer readable program code means embodied therein for
15   causing detection of a watermark in a marked image, the computer
16   readable program code means in said article of manufacture
17   comprising computer readable program code means for causing a
18   computer to effect the steps of claim 15.

19   51. An article of manufacture comprising a computer usable medium
20   having computer readable program code means embodied therein for
21   causing detection of a watermark in a marked image, the computer
22   readable program code means in said article of manufacture
23   comprising computer readable program code means for causing a
24   computer to effect the steps of claim 16.

25   52. An article of manufacture comprising a computer usable medium
26   having computer readable program code means embodied therein for

1 causing generation of a visual representation of a data array of
2 data elements, the computer readable program code means in said
3 article of manufacture comprising computer readable program code
4 means for causing a computer to effect the steps of claim 39.

5 53. An article of manufacture comprising a computer usable medium
6 having computer readable program code means embodied therein for
7 causing a watermark to be imparted onto a digitized image, the
8 computer readable program code. means in said article of
9 manufacture comprising computer readable program code means for
10 causing a computer to effect the steps of claim 18.

11 54. An article of manufacture comprising a computer usable medium
12 having computer readable program code means embodied therein for
13 causing a watermark to be imparted onto a digitized image, the
14 computer readable program code means in said article of
15 manufacture comprising computer readable program code means for
16 causing a computer to effect the steps of claim 19.

17 55. An article of manufacture comprising a computer usable medium
18 having computer readable program code means embodied therein for
19 causing detection of a watermark imparted onto a digitized image,
20 the computer readable program code means in said article of
21 manufacture comprising computer readable program code means for
22 causing a computer to effect the steps of claim 20.

23 56. An article of manufacture comprising a computer usable medium
24 having computer readable program code means embodied therein for
25 causing detection of a watermark in a marked image, the computer
26 readable program code means in said article of manufacture

1   comprising computer readable program code means for causing a

2   computer to effect the steps of claim 30.

3   57. An article of manufacture comprising a computer usable medium

4   having computer readable program code means embodied therein for.

5   causing generation of a visual representation of a data array of

6   data elements, the computer readable program code means in said

7   article of manufacture comprising computer readable program code

8   means for causing a computer to effect the steps of claim 39.

9   58. An article of manufacture comprising a computer usable medium

10   having computer readable program code means embodied therein for

11   causing demonstration of an existence of a watermark in a marked

12   image, the computer readable program code means in said article

13   of manufacture comprising computer readable program code means

14   for causing a computer to effect the steps of claim 43.

15   59. A computer program product comprising a computer usable

16   medium having computer readable program code means embodied

17   therein for causing detection of a watermark in a marked image,

18   the computer readable program code means in said computer program

19   product comprising computer readable program code means for

20   causing a computer to effect the steps of claim 44.

21   60.   An apparatus to impart a watermark onto a digitized image,

22   said apparatus comprising mechanisms for implementing the method

23   of claim 1.

24   61.   An apparatus for imparting a watermark onto a digitized

25   image comprising mechanisms for implementing the method of claim

26   5.

1   63. An apparatus for imparting a watermark onto a digitized

2   image comprising mechanisms for implementing the method of claim

3   6.

4   64. An apparatus for imparting a watermark onto a digitized

5   image comprising mechanisms for implementing the method of claim

6   11.

7   65. A method for detecting a watermark in a marked image, said

8   method comprising:

9   providing said marked image having said watermark;

10   altering said marked image employing a blurring filter in

11   producing a filtered image; and

12   employing a watermark detection method upon said filtered image

13   to detect said watermark.

14   66. A method for detecting a watermark in a marked image, said

15   method comprising:

16   providing said marked image having said watermark;

17   processing the marked image and producing a screened image;

18   altering said screened image employing a blurring filter in

19   producing a filtered image; and

1   employing a watermark detection method upon said filtered image
2   to detect said watermark.

3   67. A method as recited in claim 66, wherein the step of
4   processing includes producing a derivative image by screening,
5   printing and scanning the marked image.

6   68. A method as recited in claim 15, wherein the step of aligning
7   includes altering said marked image employing a blurring filter.

8   69. A method as recited in claim 16, wherein the step of aligning
9   includes altering said marked image employing a blurring filter.

10   70. A method as recited in claim 20, wherein the step of aligning
11   includes altering said marked image employing a blurring filter.

12   71. A method as recited in claim 30, wherein the step of
13   providing includes altering said marked image employing a
14   blurring filter.

15   72. A method as recited in claim 44, wherein the step of aligning
16   includes altering said marked image employing a blurring filter.

17   73. An article of manufacture as recited in claim 51, wherein the
18   step of aligning includes altering said marked image employing a
19   blurring filter.

20   74. An article of manufacture as recited in claim 59, wherein the
21   step of aligning includes altering said marked image employing a
22   blurring filter.

1 75. An apparatus as recited in claim 62, wherein the means of
2 providing includes means for altering said marked image employing
3 a blurring filter.

4 76. A method of generating a visual representation of a data
5 array of data elements having a data array size, said method
6 comprising:

7 providing a visualizer pattern of visualizer pixels represented
8 by a visualizer array of visualizer elements, said visualizer
9 array having a visualizer array size equal to said data array
10 size, wherein each of said visualizer elements has a first
11 logical value if a corresponding visualizer pixel is a first
12 color and a complementary logical value if said corresponding
13 visualizer pixel has a second color;

14 forming a data image of image pixels represented by an image
15 array having an image array size equal to said data array size,
16 wherein an image pixel has a corresponding data element and a
17 corresponding visualizer pixel;

18 setting said data pixel to a color of said corresponding
19 visualizer pixel if a value of said data element is above a
20 predetermined threshold and to another color if said value is
21 below said predetermined threshold; and

22

23 displaying said data image to form said visual representation.

24 77. A method as recited in claim 76, wherein said data array
25 represents data resulting from a watermark detection
26 implementation.

72. A method as recited in claim 71, wherein said first color is black and said second color is white.

73. A method as recited in claim 71, wherein said threshold is set at a fifty percent success rate.

74. An article of manufacture comprising a computer usable medium having computer readable program code means embodied therein for causing generation of a visual representation of a data array of data elements, the computer readable program code means in said article of manufacture comprising computer readable program code means for causing a computer to effect the steps of claim 71.

75. A computer program product comprising a computer usable medium having computer readable program code means embodied therein for causing generation of a visual representation of a data array of data elements, the computer readable program code means in said computer program product comprising computer readable program code means for causing a computer to effect the steps of claim 71.

76. An apparatus for generating a watermarked image comprising mechanisms for implementing the method of claim 13.

77. An apparatus comprising mechanisms for implementing the method of claim 14.

78. An apparatus for detecting a watermark in a marked image comprising mechanisms for implementing the method of claim 15.

1   85. An apparatus for detecting a watermarking plane comprising
2   mechanisms for implementing the method of claim 16.

3   86. An apparatus for imparting a watermark onto a digitized image
4   comprising mechanisms for implementing the method of claim 19.

5   87. An apparatus for detecting a watermark comprising mechanisms
6   for implementing the method of claim 20.

7   88. An apparatus for detecting a watermark comprising mechanisms
8   for implementing the method of claim 30.

9   89. An apparatus for demonstrating an existence of a watermark in
10   a marked image comprising mechanisms for implementing the method
11   of claim 43.

12   90. An apparatus for detecting a watermark comprising mechanisms
13   for implementing the method of claim 44

14   91. A method for detecting a watermarking plane comprising the
15   steps of:

16   providing an image having a plurality of image pixels,
17   $u(i,j)$, with said image having I rows and J columns, and a pixel
18   in row i and column j having at least one component, marked by a
19   watermarking plane; said watermarking plane having a plurality of
20   watermarking elements, $w(i,j)$, with said watermarking plane
21   having I rows and J columns, and an element in row i and column j
22   having a brightness multiplying factor;

1   aligning said watermarking plane with said image;

2   identifying a subset of said image elements; and

3   for each pixel, u(i,j), of said subset of image pixels,
4   employing a detection scheme in determining a probability of
5   watermark detection based on a property of uniform
6   distribution of the random brightness multiplying factors or
7   the random brightness adding or subtracting factors.